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(54) **METHOD FOR MANUFACTURING
MICROELECTROMECHANICAL
COMBDRIVE DEVICE**

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310/309; 359/254

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(56) **References Cited**

U.S. PATENT DOCUMENTS

5,025,346 A	6/1991	Tang et al.	361/283
5,314,572 A	5/1994	Core et al.	156/643
5,648,618 A	7/1997	Neukermans et al.	73/862.08
5,723,353 A	3/1998	Muenzel et al.	437/51
5,726,073 A	3/1998	Zhang et al.	437/228
5,753,911 A	5/1998	Yasuda et al.	250/306
5,872,880 A	2/1999	Maynard	385/88
5,881,198 A	3/1999	Haake	385/136
5,959,760 A	9/1999	Yamada et al.	359/224
5,969,848 A	10/1999	Lee et al.	359/298
5,995,334 A	11/1999	Fan et al.	360/106
5,998,906 A	12/1999	Jerman et al.	310/309
6,000,280 A *	12/1999	Miller et al.	73/105

6,330,102 B1	12/2001	Daneman et al.	359/290
6,384,510 B1 *	5/2002	Grade et al.	310/309
6,612,029 B2 *	9/2003	Behin et al.	29/847
2001/0034938 A1	11/2001	Behin et al.	
2001/0040419 A1	11/2001	Behin et al.	
2001/0048784 A1	12/2001	Behin et al.	
2001/0050801 A1	12/2001	Behin et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

DE 296118818 12/1996 G02B 6/35

(Continued)

OTHER PUBLICATIONS

A Low Voltage, Large Scan Angle MEMS Micromirror with
Hidden Vertical Comb-Drive Actuators for WDM Routers,
Dooyoung Hah, et al., paper presented at Optical Fiber
Conference, Mar. 19, 2002, Anaheim, CA.

(Continued)

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ABSTRACT

Methods of making microelectromechanical combdrive
devices are disclosed. The device may optionally be formed
using three device layers. A moveable element and flexure
may be formed from a first device layer. The second device
layer may be attached to the first and a first set of comb teeth
are formed from the second device layer. One or more comb
teeth in the first set extend from a major surface of the
moveable element. A third device layer is attached to the
second device layer and a second set of comb teeth are
formed from the third device layer. An alignment target is
formed in the first device layer. Corresponding alignment
holes are formed in the second or third device layers.

26 Claims, 4 Drawing Sheets

